

Association Between Outcomes and Dental Services in People With Substance Use Disorder: A Rapid Response Review

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None of the investigators have any affiliations or financial involvement that conflicts with the material presented in this report.

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Preface

Recognized for excellence in conducting comprehensive systematic reviews, the Agency for Healthcare Research and Quality (AHRQ) is expanding its portfolio to include rapid evidence products. The program has begun to develop a range of rapid evidence products to assist end users in making specific decisions in a limited timeframe.

To shorten timelines, reviewers must make strategic choices about which processes to abridge. Common adaptations to provide rapid evidence include narrowly focusing questions, limiting the number of databases searched and/or modifying search strategies, using a single reviewer and/or abstractor with a second to provide verification, and restricting to studies published in the English language. However, the adaptations made for expediency may limit the certainty and generalizability of the findings from the review, particularly in areas with a large literature base. Transparent reporting of the methods used, the resulting limitations of the evidence synthesis, and the strength of evidence of included studies is extremely important. While tradeoffs will likely differ for each topic, they are described so readers can adjudicate the limitations of the findings and conclusions of the review.

AHRQ expects that these rapid evidence products will be helpful to health plans, providers, purchasers, government programs, and the healthcare system as a whole. Transparency and stakeholder input are essential to the Effective Health Care Program.

If you have comments on this report, they may be sent by mail to the Task Order Officer named below at: Agency for Healthcare Research and Quality, 5600 Fishers Lane, Rockville, MD 20857, or by email to epc@ahrq.hhs.gov.

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Association Between Outcomes and Dental Services in People With Substance Use Disorder: A Rapid Response Review

Purpose of Review

This review is undertaken to answer the following questions:

Key Question 1: What is the effectiveness of dental services in improving health outcomes in people with substance use disorder (SUD) before, during, or after SUD pharmacologic treatment, including but not limited to transmucosal (sublingual/buccal) buprenorphine and psychotropic drugs?

Key Question 2: What are the clinical practice guidelines or standards for dental care for people with SUD?

Key Messages

Key Messages:

- The body of evidence on the effectiveness of dental services in improving health outcomes in people with SUD before, during, or after SUD pharmacologic treatment is limited to one study, and therefore, there is insufficient evidence to draw conclusions for Key Question 1.
- A U.S.-based controlled interventional study compared patients receiving SUD inpatient with and without comprehensive dental treatment reported that those who received comprehensive dental treatment had statistically significantly higher rates of SUD treatment completion, lower rates of dropout against medical advice, longer retention in the SUD treatment program, greater improvement in drug abstinence, greater improvement in employment and greater reduction in homelessness.
- All three U.S.-based dental care guidelines for people with SUD recognize common oral health concerns associated with SUD and recommend preventive oral care.
- Additionally, all three dental care guidelines acknowledge the oral side effects associated with SUD medication assisted treatment, namely buprenorphine, suboxone, and methadone, and outline strategies to reduce the risk of these side effects.
- Two guidelines stress that collaboration between medical and dental professionals to optimize the overall health management for people with SUD.

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1. Background

Substance use disorder (SUD) is a mental health condition characterized by the inability to control the use of substances such as legal or illegal drugs, alcohol, and/or medications, and can result in addiction or dependence. The Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM-5) defines SUD as a pattern of substance use that causes significant impairment or distress and meeting 11 diagnostic criteria occurring within a 12-month period.¹ These criteria are categorized into four types: impaired control, physical dependence, social problems, and risky use. SUD can result from the use of 10 separate classes of drugs: alcohol, caffeine, cannabis, hallucinogens, inhalants, opioids, sedatives, hypnotics or anxiolytics, stimulants (including amphetamine-type substances, cocaine, etc.), and tobacco. It is not uncommon to have more than one SUD at a time. According to the Substance Abuse and Mental Health Services Administration's 2022 National Survey on Drug Use and Health, 48.7 million people aged 12 or older (17.3%) had a SUD in the past year, with rates of substance use and misuse similar across racial and ethnic groups.²

The severity of SUD ranges from mild, defined as exhibiting two to three symptoms, to severe, presenting with six or more symptoms.¹ Treatment of SUD often begins with withdrawal management (also known as detox), followed by long-term therapies that may involve cognitive behavioral therapy, dialectical behavior therapy, and pharmacological treatments.³ Some examples of FDA-approved medications for SUD include methadone, buprenorphine, and naltrexone for opioid use disorder; naltrexone, acamprosate, and disulfiram for alcohol use disorder; and nicotine patch, bupropion, and varenicline for tobacco use disorder.⁴

People with SUD face increased rates of oral health problems, including dental caries, periodontal disease, oral abscesses, mucosal dysplasia, and xerostomia.⁵⁻⁸ These conditions can result from direct effects of substances on the oral cavity, such as physiological changes like dry mouth or behavioral oral changes like teeth grinding. Additionally, behavioral and socioeconomic factors associated with SUD, such as poor oral hygiene, neglected oral health problems, and reduced access to dental services, play a significant role in aggravating these oral health issues.⁹ For example, one of the most striking links between SUD and oral health is “meth mouth”, which refers to severe tooth decay brought on by the acidity of methamphetamine, and is further compounded by drug-induced dry mouth, behavioral changes, such as increased sugar cravings, teeth clenching, and poor oral hygiene, as well as the general behavioral disruption of routine in managing health and accessing dental services. These combined factors often lead to devastating tooth loss in individuals with methamphetamine use disorder.^{10,11}

Furthermore, pharmacologic treatments for SUD and their administration routes can also impact oral health, especially in the case of buccal/sublingual treatments. For instance, oral prescription methadone, a common treatment for opioid use disorder, contains high sugar concentrations and has been associated with sugar cravings and an increased risk of dental caries.¹² Similarly, sublingual buprenorphine has been associated with an increased risk of dry mouth and tooth damage, potentially due to its acidic nature and the administration of holding tablets under the tongue for 5-10 minutes for full absorption.¹³ In response, the U.S. Food and Drug Administration (FDA) issued a formal warning regarding buprenorphine medications that dissolve in the mouth, and their potential to lead to tooth decay, cavities, oral infections, and tooth loss, in people with or without a history of dental issues.¹⁴

Despite the high prevalence of oral health issues among people with SUD and the association between SUD and oral health concerns, the impact of dental care on treatment outcomes in this population is unclear. The Centers for Medicare and Medicaid Services has partnered with the

1. Background

Agency for Healthcare Research and Quality to identify dental services inextricably linked and substantially related to the clinical success of Medicare-covered medical services for people with SUD. This rapid response aims to summarize the evidence from current literature on the impact of dental services and oral health management for people with SUD, and was guided by two Key Questions (KQ) outlined below:

Key Question 1: What is the effectiveness of dental services in improving health outcomes in people with substance use disorder (SUD) before, during, or after SUD pharmacologic treatment, including but not limited to transmucosal (sublingual/buccal) buprenorphine and psychotropic drugs?

Key Question 2: What are the clinical practice guidelines or standards for dental care for people with SUD?

2. Methods

Guided by established best practices for rapid evidence reviews,¹⁵ the process of this rapid review included the following phases:

- Literature search
- Study screening and selection
- Data extraction of primary studies and systematic reviews (SRs)
- Risk of bias (RoB) assessment of individual studies and SRs
- Data synthesis, i.e., evidence mapping to Key Questions and qualitative synthesis

2.1 Literature Search

We conducted literature searches across the following biomedical databases for peer-reviewed randomized controlled trials (RCTs), observational studies, SRs, and clinical practice guidelines: Ovid Medline®, Embase®, APA PsycINFO®, and Ovid Emcare. An experienced librarian conducted these searches, using a combination of medical subject headings (i.e., controlled vocabularies) and keywords, adapted to each database's syntax. The search strategies included terms for both the intervention and disease condition, along with Boolean operators. Results were limited to English language studies on human participants and covered publications from the last 20 years (from 2004 to present).

Appendix A includes a detailed search strategy. SRs were also reviewed, and their citations cross-referenced to ensure that no relevant articles were missed in the initial searches.

To address KQ2, we conducted a manual search for clinical practice guidelines or standards of dental care in the following professional organization websites: Centers for Disease Prevention and Control, Health Resources and Services Administration, World Health Organization, National Institute for Health and Care Excellence, American Dental Association, American Academy of Oral Medicine, National Institute of Mental Health, American Academy of Addiction Psychiatry, American Society of Addiction Medicine, Association for Addiction Professionals, and American College of Physicians. We also consulted our clinical subject matter experts (SMEs) for relevant clinical practice guidelines.

2.2 Study Screening and Selection

We based our study selection on the predefined Population, Intervention, Comparator, Outcome(s), Timing, and Setting (PICOTS) inclusion and exclusion criteria in **Table 1**. We used Covidence¹⁶ to manage the screening of the articles. We selected studies in a two-step process. First, two team members independently reviewed all the titles and abstracts identified from the literature database searches and resolved conflicts through discussion and consensus. The second step was the retrieval of full texts of relevant or potentially relevant abstracts. Two team members independently reviewed all full publications and resolved conflicts through discussion. Exclusion reasons were documented at the full-text level. Clinical SMEs reviewed the list of eligible inclusions to ensure that no influential or landmark publications within the clinical community were missed and to identify publications that lacked clinical applicability for exclusion.

2. Methods

Table 1. Study eligibility (PICOTS) criteria

Category	Inclusion Criteria	Exclusion Criteria
Population	Adults ≥18 years with SUD per NIMH or CDC definition and DSM-5 criteria	<ul style="list-style-type: none"> • People 0-17 years of age • People with oral cancer
Intervention	Dental services initiated before, during or after pharmacologic treatment for SUD: <ul style="list-style-type: none"> • Routine professional preventive dental services (exam/cleaning) • Any dental treatment including but not limited to periodontitis treatment, tooth extraction, root canal, dental implant 	<ul style="list-style-type: none"> • Interventions other than professional dental services • Home oral hygiene practices
Comparator	No comparator group was required.	-
Outcome(s)	<ul style="list-style-type: none"> • Burden of dental pathology • Local and systemic infection • Nutrition related outcomes • Adverse effects of pharmacologic treatments 	<ul style="list-style-type: none"> • Not SUD disease related outcomes • Dental health or dental procedure outcomes • Numeric data not available
Timing	Follow-up time: any duration post-dental treatment	-
Setting	<ul style="list-style-type: none"> • Inpatient and outpatient settings in the United States (or its territory, embassy, or military installation) • Other countries may be included if insufficient studies (less than 10 studies and/or systematic reviews) are available from the US alone 	-
Study Design	<ul style="list-style-type: none"> • Systematic reviews with or without meta-analyses • Randomized controlled trials • Comparative or non-comparative, prospective or retrospective observational studies, including cohorts, case-controls, population studies • Clinical practice guidelines 	<ul style="list-style-type: none"> • Narrative reviews • Laboratory studies • Animal studies • Non-clinical publications • Conference abstracts
Language	English language publications	Non-English language publications
Publication dates	<ul style="list-style-type: none"> • Primary studies: 2004 – 2024 • Systematic reviews: 2004 – 2024 • Clinical practice guidelines: 2004 – 2024 	Publications outside of the defined date range

Abbreviations: CDC = Centers for Disease Control and Prevention; DSM = Diagnostic and Statistical Manual of Mental Disorders; NIMH = National Institute of Mental Health; SUD = substance use disorder.

2.3 Data Extraction

One reviewer extracted data from the included studies, and another reviewer verified the accuracy of the data.

For each included primary study, we extracted the following information:

- General study characteristics: author, year of publication, country, funding source

2. Methods

- Study design: study design, study population eligibility criteria, sample size, follow-up duration, setting
- Study population characteristics: age, gender/sex, race/ethnicity, comorbidities, SUD substance type, treatment for SUD
- Intervention: dental services including routine professional dental care (exam/cleaning), any dental treatment, any patient education on oral health by a dentist or dental professional, timing of dental services relative to treatment for SUD
- Outcomes of interest: listed in **Table 1**

For each included SR, we extracted the following information:

- Date ranges of the literature search
- Number and study design of included primary studies
- The primary conclusions
- Any strength of evidence assessment that was performed
- Outcomes of interest: listed in **Table 1**

2.4 Risk of Bias Assessments

We assessed the methodological quality of included primary studies using Cochrane Risk of Bias (RoB2)¹⁷ for RCTs, Cochrane ROBINS-I¹⁸ for non-randomized controlled interventional studies, and the Newcastle-Ottawa scale¹⁹ for cohort and case-control studies. We assessed SRs using AMSTAR2.²⁰ RoB2 determined RCTs to have low risk of bias, some concerns, or high risk of bias. ROBINS-I gave non-randomized controlled interventional studies a score of low, moderate, serious, or critical risk of bias. AMSTAR2 classified systematic reviews as high, moderate, low, or critically low confidence. To facilitate better comprehension, we mapped the quality of evidence across the three different tools to the United States Preventive Services Task Force (USPSTF)²¹ 3-point scale of good, fair, and poor quality, as shown in **Table 2** below.

Table 2. Mapping quality terms from risk of bias assessments of included studies

USPSTF quality term used in this report	AMSTAR2 Rating	ROBINS Rating	RoB2 Rating
Good	High confidence	Low risk of bias	Low risk of bias
Fair	Moderate confidence	Moderate risk of bias	Some concerns
Poor	Low confidence	Serious risk of bias	High risk of bias
	Critically low confidence	Critical risk of bias	N/A

2.5 Data Synthesis

We developed a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)²² flow diagram to illustrate the number of studies involved in the literature search and each step of the study selection process. We compiled data into evidence tables and synthesized them narratively and visually. In addition to qualitative synthesis, we organized summary tables by Key Questions and by outcome of interest when appropriate. We highlighted any gaps in evidence, with attention given to direct comparisons between the receipt of dental care and SUD related outcomes. The subgroup analysis was narrative and was done to assess outcomes reported in at least three studies. We consulted our clinical SMEs to answer KQ2 by using select references from the literature and/or from clinical practice guidelines. In our report, we provided

2. Methods

key information and data from these references. The clinical SMEs reviewed the final report to ensure accurate clinical contextualization of any findings.

3. Results

3.1 Literature Search Findings

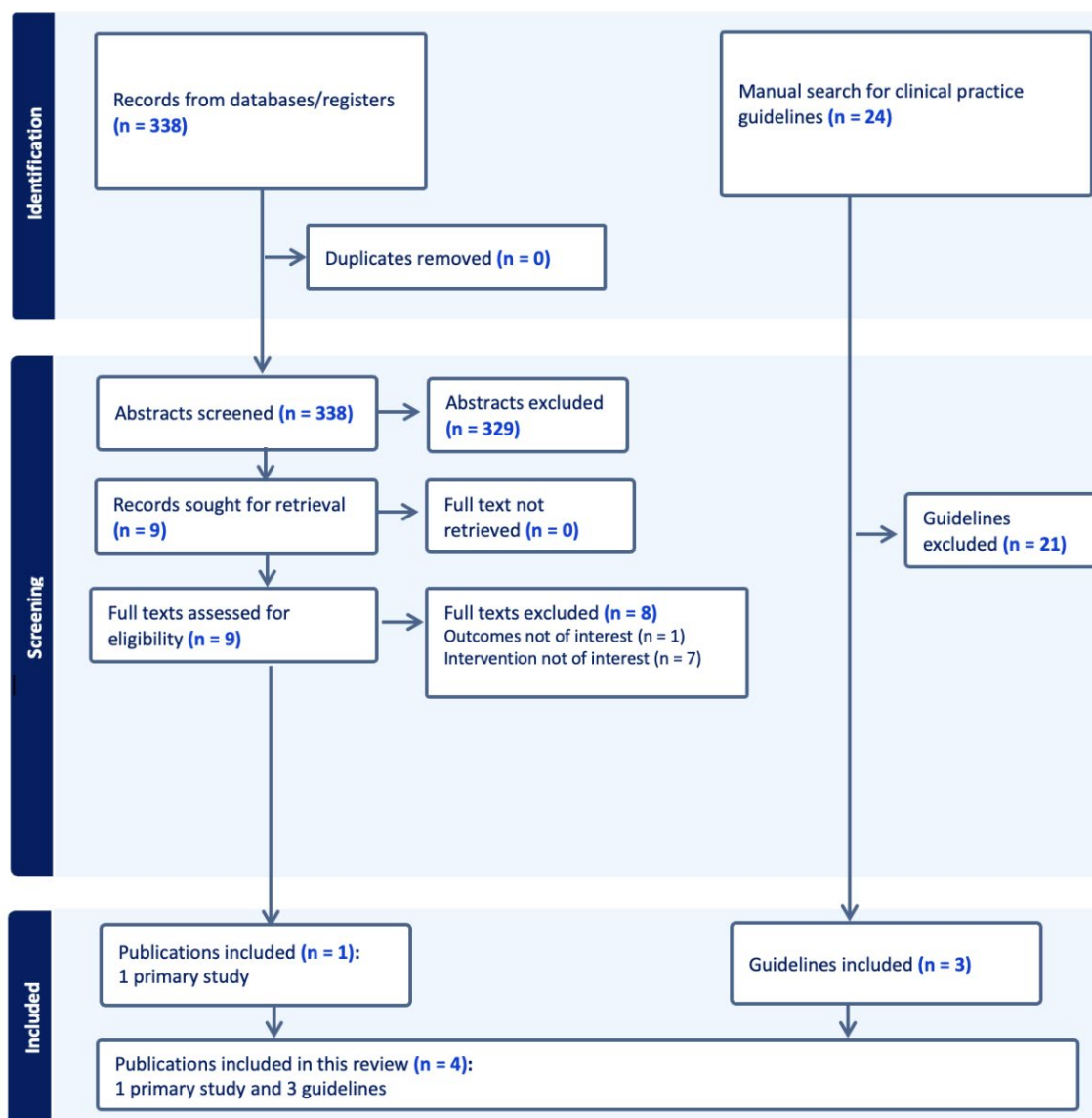
Figure 1 depicts the PRISMA flow diagram summarizing the literature search results. An electronic database search on October 14, 2024, in Ovid Medline®, Embase®, APA PsycINFO®, and Ovid Emcare yielded 338 citations. The titles and abstracts of all 338 citations were screened for eligibility, of which 329 were excluded. Of the nine full-text articles retrieved and reviewed for eligibility, eight were excluded due to irrelevant outcomes or interventions. Thus, the electronic database search found one unique publication for this rapid response review. Appendix B provides a list of references excluded at the full-text level and their reasons for exclusion.

Our manual literature searches for clinical practice guidelines for people with SUD yielded 24 articles, of which three included dental care management recommendations. Appendix C provides a list of 21 guidelines excluded due to the lack of dental care information.

Therefore, this rapid response review included data from four publications, including one primary study addressing KQ1 and three guidelines addressing KQ2.

3.1 Results, Literature Search Findings

Figure 1. PRISMA flow diagram



3.2 Key Question 1

Key Question 1: What is the effectiveness of dental services in improving health outcomes in people with substance use disorder (SUD) before, during, or after SUD pharmacologic treatment, including but not limited to transmucosal (sublingual/buccal) buprenorphine and psychotropic drugs?

3.2.1 Key Points

- Evidence regarding the effectiveness of dental services on health outcomes among people with SUD is limited to one good-quality primary study.

3.2.1 Results, Key Question 1, Key Points

- A good-quality, large US-based controlled interventional study (n=1,290) compared patients receiving SUD treatment in inpatient facilities with and without comprehensive dental treatment.
- Patients who received comprehensive dental treatment had statistically significantly higher rates of SUD treatment completion, lower rates of dropout against medical advice, longer retention in the SUD treatment program, greater improvement in drug abstinence, greater improvement in employment and greater reduction in homelessness.
- Details on the type of SUD pharmacological treatment in this study were unavailable. The effect of individual dental treatment could not be delineated. Generalizability of these findings to people with SUD in outpatient treatment programs may be limited.

3.2.2 Included Studies

Our literature database search identified one primary study that assessed the effect of dental services on health outcomes among people with SUD. There was no relevant SR.

3.2.2.1 Study Design and Population Characteristics

Table 3 provides an overview of the study design and population characteristics of the included primary study. This US-based study was conducted in two SUD treatment facilities in Utah (First Step House and Odyssey House), where patients with high-severity level of various types of SUD (including heroin, methamphetamine, alcohol, marijuana, etc.) received standard step-down SUD therapies that began in an inpatient setting and progressed to outpatient and long term management status as appropriate.²³ The study population from the two facilities were “similarly treated for SUD,” and both dental treatment and control groups received SUD treatment and drug screenings “in a similar fashion.” Details of the SUD medication used were unavailable. All patients at the First Step House were men, whereas the Odyssey House treated both male and female patients. In this study, patients aged between 20 and 50 years, diagnosed with SUD by DSM-5 criteria for primary drug of choice at start of SUD program, on inpatient treatment for at least one month, with dental needs (either self-identified in First Step House or determined by a case worker in Odyssey House), and expressed interest in receiving no-cost dental services were eligible for enrollment. Participants in Odyssey House were randomized into the comprehensive dental treatment (n=128) or control (n=142) groups, whereas those in the First Step House were self-selected or staff-assigned into dental treatment (n=158) or control (n=862) groups. The comprehensive dental treatment included a variety of dental procedures, such as surgical extraction, periodontal procedures such as scaling and root planing, amalgam or composite restoration, porcelain or cast metal crown, endodontic procedure, and partial or full removable dentures. Patients in the control group did not receive dental treatment unless a dental emergency arose. Patients were followed until discharge from the program, but the average follow-up duration was unavailable. Reported outcomes at both treatment facilities included retention in the SUD treatment program, the proportion of dropouts from the SUD treatment against medical advice, and the proportion of SUD treatment program completion. In addition, drug abstinence, employment, and homelessness were assessed at First Step House only. Since this study was partly randomized and non-randomized, we used the ROBINS-I tool to assess its risk of bias, as shown in Appendix D. We rated this study at low risk of bias (good quality).

3.2.2 Results, Key Question 1, Included Studies

Table 3. Study design and population characteristics of the included primary studies

Author Year	Study Design: Sample Size	Study Inclusion Criteria	Mean Age Male % Type of SUD Treatment for SUD	Intervention Group Treatment Control Group Treatment	Outcomes Assessed
Country Funding Risk of Bias	Followup Length				
Hanson 2019²³ US Health Resources and Services Administration and the National Institute on Drug Abuse, National Institutes of Health Low RoB/good quality	Comparative cohort study (First Step House): 1020 RCT (Odyssey House): 270 Follow-up NR (at discharge)	20-50 yr; either self-declared (First Step House) or identified by a case worker (Odyssey House) as having significant dental needs; expressed interest in no- cost dental treatment; completed inpatient SUD treatment for 1- 2 months	37 yr First Step House: 100% Odyssey House: 61.9% Various types of SUD: heroin, methamphetamine, alcohol, marijuana, other Inpatient SUD treatment at either First Step House or Odyssey House ^a	Comprehensive dental treatment: surgical extractions, periodontal procedures such as scaling and root planing, amalgam or composite restorations, porcelain or cast metal crown, endodontic procedure, and partial or full removable denture Controls: dental care only managed on an emergency basis according to policy of community free clinics	- Retention in SUD treatment - SUD treatment dropout - SUD treatment completion - Employment (First Step House only) - Homelessness (First Step House only) - Drug abstinence (First Step House only)

Abbreviations: NR: not reported; RCT: randomized controlled trial; RoB: risk of bias; SUD: substance use disorder.

^aAccording to the First Step House website, treatment modalities include “Trauma-informed Care, Moral Reconciliation Therapy, Cognitive Behavioral Intervention, Rational Emotive Behavior Therapy, Assertive Community Treatment, Dialectic Behavior Therapy, Motivational Interviewing, Medication Assisted Treatment, Individual Placement and Support, Housing First, Critical Time Intervention, Service Prioritization Decision Assistance Tool, TALER (Tracking, Assessment, Linkage, Engagement, and Retention) Protocol, Contracts/Prompts/Reinforcement, and Freedom from Smoking.”²⁴

3.2.2.2 Reported Outcomes

Table 4 illustrates the results from the included study. There were statistically significant differences in all reported outcomes.²³ Patients who received comprehensive dental treatment were significantly more likely to complete the SUD treatment program than those in the control group (HR [95% CI]: 3.24 [2.35 to 4.46], $p < 0.001$). This difference was observed in both the all-male First Step House and the co-ed Odyssey House facilities. Patients who received comprehensive dental treatment also had significantly longer retention in the SUD treatment program ($p < 0.001$) and lower dropout against medical advice ($p < 0.001$) when compared with the control group. In addition, results from First Step House revealed that patients who received comprehensive dental treatment had significantly greater improvement in employment (OR [95%

3.2.2 Results, Key Question 1, Included Studies

CI]: 2.44 [1.66 to 3.59], $p<0.01$), greater improvement in drug abstinence (OR [95% CI]: 2.19 [1.644 to 3.33], $p<0.01$), and reduction in homelessness (OR [95% CI]: 0.27 [0.11 to 0.68], $p<0.01$).²³

Table 4. Summary of findings in the included primary studies

Author Year Country	Study Design Sample Size Followup Length Type of SUD Treatment Comparison	Outcomes Assessed	Results in the Treatment Group	Results in the Control Group	Summary of Statistically Significant Findings of the Treatment Group vs. Control Group
Hanson 2019²³ US	Comparative cohort study (First Step House): 1020 RCT (Odyssey House): 270 Follow-up duration NR SUD type: various Comprehensive oral health vs no dental treatment	Retention in SUD treatment	First Step House: 256d Odyssey House, men: 273d Odyssey House, women: 316d	First Step House: 143d Odyssey House, men: 92d Odyssey House, women: 83d	Patients who received dental treatment had significantly longer retention at SUD treatment than those who did not receive dental treatment ($p<0.001$).
		Percentage of dropout from the SUD treatment against medical advice	First Step House: 28% Odyssey House, men: 24% Odyssey House, women: 21%	First Step House: 50% Odyssey House, men: 39% Odyssey House, women: 62%	Patients who received dental treatment had significantly lower dropout rate, than those who did not receive dental treatment ($p<0.001$).
		SUD treatment completion	First Step House: 72% Odyssey House, men: 76% Odyssey House, women: 79%	First Step House: 50% Odyssey House, men: 61% Odyssey House, women: 38%	HR (95% CI): First Step House: 3.6 (2.4 to 5.4) Odyssey House: 3.39 (1.84 to 6.26) Both: 3.24 (2.35 to 4.46) all $p<0.001$
		Drug abstinence (% change in number of individuals)	First Step House: 257% increase	First Step House: 138% increase	OR (95% CI): 2.19 (1.44 to 3.33) $p<0.01$
		Employment (% change in number of individuals)	First Step House: 460% increase	First Step House: 130% increase	OR (95% CI): 2.44 (1.66 to 3.59) $p<0.01$
		Homelessness (% change in number of individuals)	First Step House: 84% decrease	First Step House: 52% decrease	OR (95% CI): 0.27 (0.11 to 0.68) $p<0.006$

Abbreviations: d: days; HR: hazard ratio; NR: not reported; OR: odds ratio; RCT: randomized controlled trial; SUD: substance use disorder.

3.3 Key Question 2

Key Question 2: What are the clinical practice guidelines or standards for dental care for people with SUD?

3.3.1 Key Points

- All three relevant dental management recommendations for people with SUD are US-based, with two by a professional organization or government agency and one by a group of dental professionals.
- These guidelines consistently highlight common oral health concerns among people with SUD and emphasize the importance of preventive oral care, such as regular dental examinations, the use of fluoride toothpaste, the use of antimicrobial mouthwash, oral hygiene instructions, limiting sugary food and drinks, and proper hydration.
- All three dental care guidelines recognize the oral side effects associated with medication assisted treatment, namely buprenorphine, suboxone, and methadone, and outline strategies to reduce the risk of these side effects.
- Two guidelines stress that collaboration between medical and dental professionals to optimize the overall health management for people with SUD.

3.3.2 Included Guidelines

Our electronic literature database and manual searches identified three US-based dental management guidelines and recommendations for people with SUD. Two were published by professional organizations or government agencies,^{25,26} and one was a narrative review with dental care recommendations.²⁷ **Table 5** provides a summary of these three relevant guidelines and recommendations.

All three dental care guidelines consistently highlight oral health challenges faced by people with SUD, including dental caries, dry mouth, oral infections, reduced saliva flow, acidic oral environments, bad breath, bruxism, jaw pain, and gum disease (gingivitis and periodontitis).²⁵⁻²⁷ To manage these common oral issues, all three guidelines recommend preventive dental care strategies, such as regular dental examinations, the use of fluoride toothpaste, the use of antimicrobial mouthwash, oral hygiene instructions, limiting sugary food and drinks, and proper hydration.²⁵⁻²⁷

Furthermore, all three dental care guidelines recognize the oral side effects associated with medication assisted treatment for SUD.²⁵⁻²⁷ The American Dental Association (ADA) coined the combination of buprenorphine, suboxone, and methadone “Perfect Storm for Dental Disease”.²⁶ All three guidelines provide specific strategies for patients receiving these medications. For example, all three guidelines instruct patients on medication assisted treatment to rinse their mouth immediately after the medication dissolves.^{25,27} Both the ADA and the Oral Health Guidance for Healthcare Professionals by the Rhode Island Department of Health suggest patients to wait at least an hour after medication intake to brush their teeth.^{25,26} In addition, Cuberos et al. recommends drinking methadone through a straw.²⁷

Two guidelines emphasize the importance of collaboration between medical and dental professionals to optimize the overall health management for these patients.^{26,27} Cuberos et al. recommends only palliative and emergency treatment for patients who are not in the remission/recovery phase.²⁷

3.3.2 Results, Key Question 2, Included Guidelines

Table 5. Clinical practice guidelines or standards of dental care for people with SUD

Professional Organization or Source	Title (Year)	Type of Publication; Substances; Target Audience	Summary of Recommendations
American Dental Association²⁶	Helping Dental Professionals Identify and Support Patients with Substance Use Disorders (unknown year)	practice guide; opioids and other substances not specified; dental professionals	This is a practice guide for dental professionals who care for people with SUD. It included considerations for intake assessment, details on the risks of using buprenorphine, suboxone and methadone, and patient instructions to prevent oral diseases.
Rhode Island Department of Health²⁵	Oral Health Guidance for Healthcare Professionals Treating Patients with Substance Use Conditions (unknown year)	guidance; opioids, anxiety drugs, anti-diarrheal drugs, antidepressants, stimulants, alcohol, cannabis, tobacco/nicotine; healthcare professionals	This guidance described common side effects of several types of SUD and provided dental care recommendations for the following oral health concerns: (i) reduced saliva flow and high risk for tooth decay, (ii) acidic oral environment, (iii) bad breath/oral malodor, (iv) bruxism, oral soreness, and jaw joint and muscle pain, and (v) gum disease (gingivitis and periodontitis).
Cuberos et al., 2020²⁷	Dental management of patients with substance use disorder (2020)	narrative review with recommendation; alcohol, cannabis, methamphetamine, opioids, cocaine, tobaccos; dental and public health professionals	<p>This is a narrative review of oral health concerns among the SUD population, with recommendations for dental management.</p> <ul style="list-style-type: none"> - Specific precautions were outlined for patients with alcoholism, cocaine, ecstasy, and methamphetamines, cannabis, and opioids. - For people with SUD who are not in the remission/recovery phase, only palliative and emergency treatment should be performed. - For people with SUD who are in remission/recovery, definitive treatment must include preventive measures to improve oral hygiene and reduce the risk and burden of oral disease. - Collaboration across multiple disciplines is vital. - Detailed recommendations for patients on SUD medications included oral rinse immediately after medication intake, adequate hydration, chewing gum, and drinking methadone through a straw.

4. Discussion

4.1 Overview

The objective of this rapid response is twofold: (i) to identify and synthesize the existing evidence on the effectiveness of dental services in improving health outcomes in people with SUD before, during, or after SUD pharmacologic treatment, and (ii) to the review standard of dental care practices for this patient population. Our literature review identified one controlled interventional study and three relevant guidelines.

The evidence evaluating the effectiveness of dental services on SUD outcomes is limited and comprises of only one primary study. One large US-based study of people with SUD from two inpatient treatment facilities (First Step House and Odyssey House), compared patients who received comprehensive dental treatment and those without dental care.²³ Men and women in Odyssey House were randomized to dental or control groups, while all patients at First Step House were men and were self- or staff-assigned to treatment groups. The included study combines randomized and non-randomized elements. Such randomization inconsistencies may affect the internal validity and comparability of results. All study participants received similar SUD inpatient treatment; however, information on the type of pharmacological treatment was unavailable. While the comprehensive dental treatment included a variety of dental procedures, such as surgical extraction, periodontal procedures, amalgam or composite restoration, porcelain or cast metal crown, endodontic procedure, and partial or full removable dentures, results demonstrating the effect of specific dental treatment type were not evaluated. This study followed patients till discharge from the SUD treatment program, so long-term impact of the comprehensive dental treatment is unknown. Nonetheless, this sizable study (total N=1,290) provided data on relevant outcomes. Compared with patients in the control group, patients who received comprehensive dental treatment showed statistically significantly favorable results in all measures: drug abstinence, SUD treatment completion rate, rate of dropout against medical advice, retention in the SUD treatment program, employment, and homelessness. It is unknown if these effects are generalizable to patients in outpatient SUD treatment programs or if these observed favorable effects persist long-term beyond discharge from the SUD treatment program.

Our literature database search aimed to capture a wide range of relevant publications: any professional dental treatments, any type of SUD or dependency as defined by DSM-5, and both interventional and observational studies published in the last 20 years. Despite the broad study selection criteria, only one primary study was eligible for inclusion. This is likely due to several reasons. First, the nature of SUD poses unique challenges for research, because studies with people with SUD often have high dropout rates (i.e. high proportion of missing data),²⁸ and people with SUD may not have the ability to provide informed consent to enroll into clinical or epidemiological studies.²⁹ Second, many studies evaluated the role of dental care providers in delivering smoking-cessation intervention, not dental treatment.^{30–37} Third, several studies that evaluated dental care aimed to evaluate dental health outcomes and not SUD treatment outcomes.^{38–40} Our literature search found one study that reported non-dental health outcomes.⁴¹ This single-arm interventional study enrolled smokers who received non-surgical periodontal treatment in Saudi Arabia and reported non-dental health outcomes, including salivary flow rate, salivary interleukin-1 β , and salivary cortisol levels.⁴¹ However, this study did not provide patients with any smoking cessation or other SUD treatments. Therefore, the results did not provide the relevant effectiveness data as specified in Key Question 1.

4. Discussion

Given the high prevalence of oral health issues among people with SUD, practice guides and dental management recommendations consistently encourage dental services to manage the potential oral-related side effects of SUD medications (buprenorphine, naloxone, and methadone). Despite the lack of evidence on the effectiveness of dental care among people on SUD pharmacological treatment, all reviewed guidelines recommend preventive oral health strategies such as oral rinse immediately after taking SUD medications, proper hydration to combat xerostomia, routine oral examinations to monitor dental health, use of fluoride toothpaste, use of antimicrobial mouthwash, and oral hygiene education.

4.2 Strengths and Limitations

This rapid response was strengthened by a rigorous methodology following rapid review best practices and the comprehensive database search that covered a broad categories of study designs, a wide range of dental services, all types of SUD, without geographic restrictions. Our clinical practice guideline search was further enhanced by the manual search of many relevant professional organization websites.

The findings of this rapid response are limited by the sparse evidence base. The rapid nature of the process limited the ability to reach out to study authors to get additional details related to the type of SUD and particular treatments for each SUD. The only included study has limited generalizability to patients in outpatient SUD treatment programs. There is no evidence on the effect of individual dental treatment type.

5. Conclusions

The evidence on the effectiveness of dental services in improving health outcomes in people with SUD before, during, or after SUD pharmacologic treatment is sparse. The only included study found favorable impact of comprehensive dental treatment among people with SUD on drug abstinence, SUD treatment completion, retention in the SUD treatment program, employment and homelessness. However, several aspects of the study such as the inpatient setting in a rehabilitation facility and self-selection of some patients into the treatment arm raise questions about generalizability and internal validity. Despite the limited primary evidence, clinical practice guidelines consistently recognize the unique oral health challenges among people with SUD and consistently recommend preventive oral care and outlined specific strategies for people treated with SUD medications.

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Abbreviations and Acronyms

Acronym	Definition
ADA	American Dental Association
AHRQ	Agency for Healthcare Research and Quality
CDC	Centers for Disease Control and Prevention
CI	Confidence interval
CMS	Centers for Medicare and Medicaid Services
d	Day
DSM	Diagnostic and Statistical Manual of Mental Disorders
FDA	U.S. Food and Drug Administration
HR	Hazard ratio
KQ	Key Question
MA	Meta analysis
mo	Month
NA	Not applicable
NICE	National Institute for Health and Care Excellence
NIMH	National Institute of Mental Health
NR	Not reported
OR	Odds ratio
PICOTS	Population, Intervention, Comparator, Outcome(s), Timing, and Setting
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT	Randomized controlled trial
RoB	Risk of bias
RR	Relative risk
SME	Subject matter expert
SR	Systematic review
SRP	Scaling and root planing
SUD	Substance use disorder
USPSTF	United States Preventive Services Task Force
yr	Year

Appendix A. Literature Search Strategy

Table A-1. Search strategy, conducted on 10/14/2024

Set#	Searched for	# Results
S1	MJEMB.EXACT.EXPLODE("drug dependence") OR MJMESH.EXACT.EXPLODE("Substance-Related Disorders")	587858
S2	TI,AB,IF,SU(((alcohol OR alcohol-induced OR alcohol-related OR amphetamine\$1 OR barbiturate\$1 OR benzodiazepine\$1 OR cannabis OR chemical OR cocaine OR drug\$1 OR drug-seeking OR ecstasy OR MDMA OR ethanol OR EtOH OR fentanyl OR glue OR glue-sniffing OR heroin OR inhalant\$1 OR marihuana OR marijuana OR methamphetamine\$1 OR morphine OR narcotic\$1 OR nicotine OR opiate\$1 OR opioid\$1 OR phencyclidine\$1 OR PCP OR smoking OR stimulant\$1 OR substance\$1 OR substance-induced OR substance-related OR tobacco OR polytobacco OR vaping) N/3 (abus\$3 OR addict\$4 OR behavio*r\$1 OR craving\$1 OR depend\$4 OR desir\$3 OR disorder\$1 OR facilitation OR habituation OR misus\$3 OR overus\$3 OR us\$3)) OR alcoholism OR narcotism OR nicotinism OR tobaccoism OR SUD\$1)	3386376
S3	S1 OR S2	3421409
S4	MJEMB.EXACT.EXPLODE("dental examination") OR MJEMB.EXACT.EXPLODE("dental prevention") OR MJEMB.EXACT.EXPLODE("dental procedure") OR MJEMB.EXACT.EXPLODE("dental prosthesis and implant") OR MJEMB.EXACT.EXPLODE("endodontics") OR MJEMB.EXACT("mouth hygiene") OR MJEMB.EXACT.EXPLODE("periodontics") OR MJEMB.EXACT.EXPLODE("preventive dentistry") OR MJEMB.EXACT.EXPLODE("prosthodontics") OR MJEMB.EXACT.EXPLODE("restorative dentistry") OR MJMESH.EXACT.EXPLODE("Dental Health Services") OR MJMESH.EXACT.EXPLODE("Endodontics") OR MJMESH.EXACT.EXPLODE("Mouth Rehabilitation") OR MJMESH.EXACT.EXPLODE("Periodontics") OR MJMESH.EXACT.EXPLODE("Preventive Dentistry") OR MJMESH.EXACT.EXPLODE("Prosthodontics") OR MJMESH.EXACT.EXPLODE("Public Health Dentistry")	457971
S5	TI,AB(((cavit\$3 OR caries OR carious OR dental OR dentistry OR "dry mouth" OR edentul* OR endodont* OR gingivitis OR *gingival OR (gum N/2 (disease* OR infection*)) OR "meth mouth" OR periodont* OR periapical OR pulpal OR pulpitis OR (oral N/2 candidiasis) OR root OR stomatitis OR teeth OR thrush OR tooth OR xerostomia) N/3 (curettage OR clean\$3 OR debridement OR exam\$1 OR examin\$6 OR fill\$3 OR hygiene OR implant* OR intervention* OR therap* OR treat* OR procedure\$1 OR planing OR prevent\$5 OR prophylaxis OR prosthes?s OR prosthetic\$1 OR prosthodontic\$1 OR repair\$3 OR restor\$5 OR scaling)) OR ((dental OR oral) N/2 (health OR hygiene)))	622382
S6	S4 OR S5	896139
S7	S3 AND S6	18819
S8	S7 NOT (EMB.EXACT.EXPLODE("pediatric dentistry") OR MESH.EXACT.EXPLODE("Dental Care for Children") OR MESH.EXACT.EXPLODE("Pediatric Dentistry") OR TI,AB(adolescent* OR baby OR babies OR child* OR infant* OR juvenile* OR teen*))	16846
S9	S8 NOT (MJEMB.EXACT.EXPLODE("mouth cancer") OR MJMESH.EXACT.EXPLODE("Mouth Neoplasms") OR TI,AB,IF,SU((oral OR mouth) N/2 (cancer* OR carcino* OR metastas?s OR neoplasm* OR malignan* OR tumo\$r*)))	15493
S10	S9 AND (TI,AB,SU,DTYPE(case-control OR ((cohort\$1 OR co-hort\$1) N/2 (analys?s OR comparat\$3 OR stud\$3 OR trial\$1)) OR ((control\$5 OR epidemiologic\$2 OR evaluat\$4 OR exploratory OR interventional OR longitudinal OR observational OR pivotal OR prospective OR random\$5 OR registrational OR retrospective) N/5 (analys?s OR evaluation\$1 OR review\$1 OR stud\$3 OR trial\$4)) OR (random\$5 N/2 control\$5) OR (systematic\$5 N/1 review\$3) OR meta-analys?s OR metanalys?s OR metaanalys?s) OR TI(guideline\$1 OR consensus OR position\$1 OR recommend\$6 OR requirement\$1 OR statement\$1 OR "task force\$1" OR "working group\$1" OR ((clinic\$5 OR committee\$1) N/3 (advisor\$4 OR practice\$1)) OR (expert\$1 N/3 (opinion\$1 OR panel\$1)) OR policy OR policies)) NOT (TI,DTYPE(conference\$1 OR meeting\$1 OR correct\$5 OR errata OR erratum OR editor\$1 OR editorial\$1 OR comment\$5 OR reply OR letter\$1 OR response\$1 OR correspondence\$1 OR note\$1) OR TI,AB,SU,DTYPE(case\$1 N/3 (report\$1 OR series OR stud\$3)))	5939

Set#	Searched for	# Results
S11	S10 NOT (TI,AB(((animal\$1 OR cell\$4 OR computational OR ex-vivo OR in-silico OR in-vitro OR in-vivo OR laboratory OR non-clinical OR nonclinical OR transgenic) N/3 (experiment\$1 OR model\$4 OR stud\$3 OR technique\$1)) OR "cell line\$1" OR rat OR rats OR murine OR murinae OR mouse OR mice OR gerbil OR gerbils OR "guinea pig" OR "guinea pigs" OR hamster OR hamsters OR rodent OR rodents OR rabbit OR rabbits OR hare OR hares OR dog OR dogs OR puppy OR puppies OR beagle\$1 OR "german shepherd\$1" OR "labrador retriever\$1" OR "golden retriever\$1" OR feline\$1 OR cat OR cats OR kitten OR kittens OR monkey OR monkees OR monkeys OR baboon\$1 OR macaque\$1 OR simian\$1 OR chimp\$1 OR chimpanzee\$1 OR orangutan\$1 OR "non-human primate\$1" OR "nonhuman primate\$1" OR porcine\$1 OR swine\$1 OR pig OR pigs OR piglet OR piglets OR equine\$1 OR horse OR horses OR bovine\$1 OR cattle OR cow OR cows OR bull OR bulls OR goat OR goats OR ovine\$1 OR sheep OR ram OR rams OR ewe OR ewes OR lamb OR lambs OR bird\$1 OR chick\$1 OR chicken\$1 OR poult\$2 OR zebrafish\$2 OR "zebra fish\$2")) [5090 results] S12 S11 AND PD(>=20040101) AND LA(English)	2428
S13	S12 AND (TI(((alcohol OR alcohol-induced OR alcohol-related OR amphetamine\$1 OR barbiturate\$1 OR benzodiazepine\$1 OR cannabis OR chemical OR cocaine OR drug\$1 OR drug-associated OR drug-related OR drug-seeking OR ecstasy OR MDMA OR ethanol OR EtOH OR fentanyl OR glue OR glue-sniffing OR heroin OR inhalant\$1 OR marihuana OR marijuana OR methamphetamine\$1 OR methamphetamine-associated OR methamphetamine-related OR morphine OR narcotic\$1 OR nicotine OR opiate\$1 OR opioid\$1 OR phencyclidine\$1 OR PCP OR smoking OR stimulant\$1 OR substance\$1 OR substance-induced OR substance-related OR tobacco OR polytobacco OR vaping) N/3 (abus\$3 OR addict\$4 OR behavior\$1 OR cessation OR craving\$1 OR depend\$4 OR desire\$3 OR disorder\$1 OR facilitation OR habituation OR misuse\$3 OR overuse\$3 OR use\$3)) OR alcoholism OR "meth mouth" OR narcotism OR nicotine OR tobaccoism OR SUD\$1))	338

Appendix B. List of Excluded Studies

Author Year	Title	Citation	Exclusion Reason
Alhumaidan 2022	Comparison of Whole Salivary Cortisol and Interleukin 1-Beta Levels in Light Cigarette-Smokers and Users of Electronic Nicotine Delivery Systems before and after Non-Surgical Periodontal Therapy	Alhumaidan, Abdulkareem A.; Al-Aali, Khulud A.; Vohra, Fahim; Javed, Fawad; Abduljabbar, Tariq International Journal of Environmental Research and Public Health 2022;19(18): MDPI 2022	Intervention not of interest
Al-Sowaygh 2017	Efficacy of periimplant mechanical curettage with and without adjunct antimicrobial photodynamic therapy in smokeless-tobacco product users	Al-Sowaygh, Zeyad H Photodiagnosis and photodynamic therapy 2017;18():260-263	Outcome not of interest
Gupta 2017	C-reactive protein in periodontitis and its comparison with body mass index and smoking behaviour	Gupta, Sujaya; Pradhan, Shaili; Sushil, K.C.; Shakya, Sonika; Giri, Mohana Journal of the Nepal Medical Association 2017;56(206):226-233	Intervention not of interest
Jaffe 2021	A paradox of need: Gaps in access to dental care among people who use drugs in Canada's publicly funded healthcare system	Jaffe, Kaitlyn; Choi, JinCheol; Hayashi, Kanna; Milloy, M.-J.; Richardson, Lindsey Health and Social Care in the Community 2021;29(6):1799-1806	Intervention not of interest
John 2023	Interventions to improve oral health and related health behaviours of substance use, smoking, and diet in people with severe and multiple disadvantage: a systematic review of effectiveness and cost-effectiveness	John, Deepti A; McGowan, Laura J; Kenny, Ryan P W; Joyes, Emma C; Adams, Emma A; Shabaninejad, Hosein; Richmond, Catherine; Beyer, Fiona; Landes, David; Watt, Richard G; Sniehotta, Falko F; Paisi, Martha; Bambra, Clare; Craig, Dawn; Kaner, Eileen; Ramsay, Sheena E Lancet (London, England) 2023;402 Suppl 1:S58	Intervention not of interest
Khaitan 2019	Liver and thyroid profile in educating smokeless tobacco users and its role in oral health promotion	Khaitan, Tanya; Shukla, Anjani Kumar; Gupta, Prashant; Naik, Shantala R; Verma, Pratik; Kumar, Surender Journal of education and health promotion 2019;8:224	Intervention not of interest
McNeely 2013	Substance-use screening and interventions in dental practices: survey of practice-based research network dentists regarding current practices, policies and barriers	McNeely, Jennifer; Wright, Shana; Matthews, Abigail G; Rotrosen, John; Shelley, Donna; Buchholz, Matthew P; Curro, Frederick A Journal of the American Dental Association (1939) 2013;144(6):627-38	Intervention not of interest
Murphy 2016	A Comparison of Methamphetamine Users to a Matched NHANES Cohort: Propensity Score Analyses for Oral Health Care and Dental Service Need	Murphy, Debra A; Harrell, Lauren; Fintzy, Rachel; Belin, Thomas R; Gutierrez, Alexis; Vitero, Steven J; Shetty, Vivek The journal of behavioral health services & research 2016;43(4):676-690	Intervention not of interest

Appendix C. List of Clinical Practice Guidelines Without Dental Care Recommendations

Professional Organization of Source	Title	Year	Type of Publication	Note
American Dental Association	Statement on Provision of Dental Treatment for Patients with Substance Use Disorders	2022	position statements	relevant to dental and SUD, but no official dental care guideline or recommendations
American Dental Association	Statement on Alcoholism and Other Substance Use Disorder	2022	position statements	relevant to dental and SUD, but no official dental care guideline or recommendations
American Dental Association	Statement on Alcoholism and Other Substance Use by Pregnant and Postpartum Patients	2022	position statements	relevant to dental and SUD, but no official dental care guideline or recommendations
Kentucky Oral Health Coalition	Dentists' Role in Substance Use Prevention and Treatment	2022	position statements	relevant to dental and SUD, but no official dental care guideline or recommendations
Shekarchizadeh et al.	Oral Health of Drug Abusers: A Review of Health Effects and Care.	2013	review with oral care management framework	narrative review with oral care framework
National Council for Mental Wellbeing	Oral Health, Mental Health, and Substance Use Treatment	2021	guide and toolkit	toolkit with oral care framework
Centers for Disease Prevention and Control	Treatment of Substance Use Disorders	Updated 2024	online article for the public	relevant to SUD but no mention of dental care
Health Resources and Services Administration	Caring for Women with Opioid Use Disorder: A Toolkit for Organization Leaders and Providers	2020	toolkit for healthcare providers	relevant to SUD but no mention of dental care
World Health Organization	Guidelines for identification and management of substance use and substance use disorders in pregnancy	2014	guideline	official guideline relevant to SUD but no mention of dental care
American Academy of Addiction Psychiatry	Core Competencies for Use of Collaborative Care in the Treatment of Substance Use Disorders A Psychiatrist's Guide	2024	guidance	guidance for SUD but no mention of dental care
American Society of Addiction Medicine	ASAM National Practice Guideline for the Treatment of Opioid Use Disorder – 2020 Focused Update	2020	guideline	official guideline relevant to SUD but no mention of dental care
American Society of Addiction Medicine	ASAM Clinical Practice Guideline on Alcohol Withdrawal Management	2020	guideline	official guideline relevant to SUD but no mention of dental care

Professional Organization of Source	Title	Year	Type of Publication	Note
American College of Physicians	Health and Public Policy to Facilitate Effective Prevention and Treatment of Substance Use Disorders Involving Illicit and Prescription Drugs: An American College of Physicians Position Paper	2017	position statements	relevant to SUD but no mention of dental care
U.S. Department of Veteran Affairs	VA/DOD Clinical Practice Guidelines: Management of Substance Use Disorder (SUD)	2021	guideline	official guideline relevant to SUD but no mention of dental care
Substance Abuse and Mental Health Services Administration	Federal Guidelines for Opioid Treatment Programs	2015	guideline for policy	relevant to SUD but no mention of dental care
Substance Abuse and Mental Health Services Administration	Detoxification and Substance Abuse Treatment: A Treatment Improvement Protocol	2015	treatment improvement protocol	relevant to SUD but no mention of dental care
Substance Abuse and Mental Health Services Administration	Treating Substance Use Disorder in Older Adults	2020	treatment improvement protocol	relevant to SUD but no mention of dental care
College of Family Physicians of Canada	Managing opioid use disorder in primary care	2019	guidance	relevant to SUD but no mention of dental care
Canadian Institutes of Health Research	Management of opioid use disorders: a national clinical practice guideline	2018	guideline	official guideline relevant to SUD but no mention of dental care
International Task Force of the World Federation of Societies of Biological Psychiatry and the International Association for Women's Mental Health	WFSBP and IAWMH Guidelines for the treatment of alcohol use disorders in pregnant women	2019	guideline	relevant to SUD but no mention of dental care
American Medical Association	Care for Substance Use Disorder	2024	guide/toolkit	relevant to SUD but no mention of dental care

Appendix D. Risk of Bias Assessments

The included study, Hanson et al.,^a was partly randomized and partly non-randomized. Therefore, we used the ROBINS-I tool to assess its risk of bias, as shown below.

Bias Domain	Signaling Question	Response Options Y/PY/N/PN/NI/ NA	Domain And Overall Scores Overall ROB Judgment (Low/Moderate/Serious/ Critical/NI)
Domain 1: Bias Due to Confounding	1.1 Is there potential for confounding of the effect of intervention in this study?	PY	--
	1.2 If Y/PY to 1.1, was the analysis based on splitting participants' follow-up time according to intervention received?	N	--
	1.3 If Y/PY to 1.2, were intervention discontinuations or switches likely to be related to factors that are prognostic for the outcome?	N/A	--
	1.4 If N/PN to 1.2 and/or 1.3, did the authors use an appropriate analysis method that controlled for all the important confounding domains?	N	--
	1.5 If Y/PY to 1.4, were confounding domains that were controlled for measured validly and reliably by the variables available in this study?	N/A	--
	1.6 Did the authors control for any post-intervention variables that could have been affected by the intervention?	N	--
	1.7 If Y/PY to 1.3 and/or 1.4, did the authors use an appropriate analysis method that adjusted for all the important confounding domains and for time-varying confounding?	NI	--
	1.8 If Y/PY to 1.7, were confounding domains that were adjusted for measured validly and reliably by the variables available in this study?	N/A	--
	Overall risk of bias (domain 1)	--	Moderate
Domain 2: Bias in selection of participants into the study	2.1 Was selection of participants into the study (or into the analysis) based on participant characteristics observed after the start of intervention?	N	--
	2.2 If Y/PY to 2.1, were the post-intervention variables that influenced selection likely to be associated with intervention?	N/A	--
	2.3 If Y/PY to 2.2, were the post-intervention variables that influenced selection likely to be influenced by the outcome or a cause of the outcome?	N/A	--
	2.4 Do start of follow-up and start of intervention coincide for most participants?	NI	--
	2.5 If Y/PY to 2.2 and 2.3, or N/PN to 2.4, were adjustment techniques used that are likely to correct for the presence of selection biases?	NI	--
	Overall risk of bias (domain 2)	--	Low
Domain 3: Bias in classification of interventions	3.1 Were intervention groups clearly defined?	Y	--
	3.2 Was the information used to define intervention groups recorded at the start of the intervention?	Y	--
	3.3 Could classification of intervention status have been affected by knowledge of the outcome or risk of the outcome?	Y	--
	Overall risk of bias (domain 3)	--	Moderate
Domain 4: Bias due to deviations from intended interventions	4.1 Were there deviations from the intended intervention beyond what would be expected in usual practice?	N	--
	4.2 If Y/PY to 4.1, were these deviations from intended intervention unbalanced between groups and likely to have affected the outcome?	N/A	--
	4.3 Were important co-interventions balanced across intervention groups?	Y	--

Bias Domain	Signaling Question	Response Options Y/PY/N/PN/NI/ NA	Domain And Overall Scores Overall ROB Judgment (Low/Moderate/Serious/ Critical/NI)
	4.4 Was the intervention implemented successfully for most participants?	Y	--
	4.5 Did study participants adhere to the assigned intervention regimen?	Y	--
	4.6 If N/PN to 4.3, 4.4, or 4.5, was an appropriate analysis used to estimate the effect of starting and adhering to the intervention?	N/A	--
	Overall risk of bias (domain 4)	--	Low
Domain 5: Bias due to missing data	5.1 Were outcome data available for all, or nearly all, participants?	PY	--
	5.2 Were participants excluded due to missing data on intervention status?	N	--
	5.3 Were participants excluded due to missing data on other variables needed for the analysis?	N	--
	5.4 If PN/N to 5.1, or Y/PY to 5.2 or 5.3, are the proportion of participants and reasons for missing data similar across interventions?	N/A	--
	5.5 If PN/N to 5.1 or Y/PY to 5.2 or 5.3, is there evidence that results were robust to the presence of missing data?	N/A	--
	Overall risk of bias (domain 5)	--	Low
Domain 6: Bias in measurement of outcomes	6.1 Could the outcome measure have been influenced by knowledge of the intervention received?	N	--
	6.2 Were outcome assessors aware of the intervention received by study participants?	NI	--
	6.3 Were the methods of outcome assessment comparable across intervention groups?	Y	--
	6.4 Were any systematic errors in measurement of the outcome related to intervention received?	NI	--
	Overall risk of bias (domain 6)	--	Low
Domain 7: Bias in selection of the reported result	7.1 Is the reported effect estimate likely to be selected, on the basis of the results, from multiple outcome measurements within the outcome domain?	N	--
	7.2 Is the reported effect estimate likely to be selected, on the basis of the results, from multiple analyses of the intervention-outcome relationship?	N	--
	7.3 Is the reported effect estimate likely to be selected, on the basis of the results, from different subgroups?	N	--
	Overall risk of bias (domain 7)	--	Low
Overall Risk of Bias	What is the overall risk of bias judgement?	--	Low risk of bias

Abbreviations: Y = yes; PY = probably yes; PN = probably no; N = no; NI = no information; N/A = not applicable

^aHanson GR, McMillan S, Mower K, et al. Comprehensive oral care improves treatment outcomes in male and female patients with high-severity and chronic substance use disorders. J Am Dent Assoc. 2019;150(7):591-601. DOI: <https://doi.org/10.1016/j.adaj.2019.02.016>.